# Current Welfare State of Pet Guinea Pigs within the United Kingdom

**Amber J Harrup, BSc (Hons) RVN, ah13426@my.bristol.ac.uk**

**Nicola J Rooney, BSc (Hons) PhD, Animal Welfare and Behaviour, University of Bristol, Langford, Bristol, BS40 5DU. Nicola.Rooney@bristol.ac.uk**

**Word count: 4421**

**Keywords:** Pet, Guinea pigs, Welfare, Housing, Husbandry, Companionship, Diet, Behaviour, Health

**Abstract**

**Background:** Little research has been carried out into how guinea pigs are cared for in the UK, and information regarding potential welfare issues is sparse. This study was designed to examine the five welfare needs, collecting data on the extent to which these are each met by a sample of UK guinea pig owners.

**Methods:** A survey of 4590 owners was conducted.

**Results:** Guinea pigs were housed in a variety of ways, but a hutch or cage, with no attached run, was the most the common enclosure. The majority reportedly lived with a conspecific, although some lived on their own, or with a rabbit. Significant associations between aspects of housing and husbandry, and behaviour and health were found, for example the frequency of positive behaviours displayed was higher in those guinea pigs housed with a conspecific and those in larger enclosures, whilst the number of reported health issues was lower in animals receiving green vegetables more often.

**Conclusion:** This study has identified common practices, and highlighted some potential welfare issues, which would benefit from further research. We suggest improved availability of targeted information may enable owners to improve issues identified here.

## INTRODUCTION

There are currently an estimated 400,000 pet guinea pigs within the United Kingdom (UK), accounting for 2.0% of the pet population [1]. Despite this, there has been little research on how they are commonly kept and cared for, nor determining optimal practice. A recent People's Dispensary for Sick Animals (PDSA) survey, although focussing primarily on dogs and cats, revealed a distinct lack of knowledge amongst pet owners about the five welfare needs [2], set out by the Animal Welfare Act (2006) [3]. When considering guinea pigs, although there is a large amount of owner targeted information available via pet food companies, charities and other websites and publications, there is a limited amount of peer reviewed research, and hence this information is of variable quality and not always evidence-based. The British Cavy Council (an umbrella organisation promoting the exhibition of purebred guinea pigs) has derived a welfare code outlining how best to meet the needs of this species [4], but this is not widely recognised and it is unknown to what extent this information is evidence-based. No such code exists for companion guinea pigs.

There are a range of factors that are likely to impact upon a guinea pig's welfare, including their physical and social environment, their interactions with their owner, their diet and their routine health care. For example, it is commonly recommended that guinea pigs should be kept in single sex pairs, female groups, or mixed sex pairs or groups [5, 6]. Preference tests have shown that when given the choice, guinea pigs choose to spend the majority of their time with a conspecific , whereas they generally choose to spend time away from a rabbit [7,8]. The presence of a compatible conspecific can also greatly reduce stress [8,9]. Whilst rabbits were previously thought to be acceptable companions for guinea pigs, it is now generally acknowledged that the two species have differing signalling and behavioural repertoires, differing nutritional needs, and rabbits have the potential to cause injury to guinea pigs, and to transmit infections such as *Bordetella*

*bronchiseptica*. Hence, interspecies cohabitation can be detrimental to health and welfare and is no longer recommended [5, 10, 1, 12, 13].

Size of the enclosure is considered important [8] and provision of daily access to an exercise area believed to encourage natural behaviours and improve health [6, 13]. Whilst little investigation has been carried out into the effects of enclosure size on guinea pig behaviour, in other species including rabbits, animals housed in smaller enclosures have been found to demonstrate a reduced behavioural repertoire, and an increase in behaviours indicative of stress and frustration [13, 14].

Balanced diets are critical as guinea pigs require 10-30mg/kg of vitamin C per day, which must be provided through diet, often via vitamin C-rich green vegetables, concentrates and other supplementation, as they are unable to produce this themselves [6, 11, 15]. Vitamin C deficiency can cause scurvy, resulting in weight loss, lameness and lethargy, as well as predisposing animals to pneumonia, enteritis and skin conditions [16]). Additionally, high fibre, good quality hay is essential to maintain dental and gastrointestinal health [11] and feeding a mix of hay types is recommended [17].

Although there is a body of research and regulations (including minimum cage size requirements) for guinea pigs kept in laboratories [4, 13, 18], empirical evidence for factors most impacting upon welfare of companion animals is currently lacking. We therefore followed the approach used by Rooney et al [19] on pet rabbits, to survey the UK guinea pig population.

Owners were asked about the way they housed and cared for their guinea pigs, including housing type and size, exercise, diet and Vitamin C provision, husbandry and cleaning regimes, companionship and veterinary care (e.g. health checks). Animal welfare is increasingly measured using outcome, rather than input-based, measures [10, 19], therefore we collected data on indicators of physical health, such as the occurrence of common health problems [20, 21, 22] and behavioural indicators of welfare, such as reported in-cage behaviour, temperament, and responses to potential stressors including handling. We asked owners about the occurrence of specific behaviours which we later classified as "positive" and "negative". Positive behaviours were those whose expression is known to be important for physical health (e.g. standing on hind limbs), and those which are thought to indicate positive affective states such as locomotory play behaviour (e.g. "popcorning"- rapid locomotion in which the animal jumps into the air with all four limbs off the ground, often accompanied by rapid running and turning in multiple directions) [6, 13, 23]. Negative behaviours were those whose expression can be symptomatic of an underlying welfare issue (e.g. chewing the cage, or teeth chattering) [6, 13].

Research into disease prevalence in guinea pigs is limited, but it is commonly thought to be affected by aspects of husbandry and diet [10, 20, 22]. For example, dental disease, the most commonly diagnosed condition affecting guinea pigs, is believed to be often associated with poor diet [22, 24. A recent survey suggested that the occurrence of bacterial infections was unrelated to level of owner knowledge, [25], but did not test for associations with specific aspects of care. Our survey asked about the occurrence of the most common diseases as reported in the literature [10, 21, 22], and compared their occurrence to animal's housing and husbandry.

We used this owner reported data to explore associations between aspects of housing and husbandry, and indicators of health and behaviours, aiming to provide a description of current housing and husbandry practices for UK pets and to highlight potential welfare issues.

Specifically we tested the hypotheses that:

- The frequency of positive behaviours is higher in guinea pigs:
    - Housed with a conspecific companion(s);
    - housed without a rabbit;
    - housed in larger enclosure sizes.
- The number of reported health issues is lower in guinea pigs:
    - Housed in larger enclosure sizes;
    - receiving green vegetables more often.

.Guinea pigs are often suggested to have a life expectancy ranging between four to nine years [10, 11, 20], and data was also collected to further explore this.

## METHOD

Ethical approval was obtained from the University of Bristol Faculty of Health Science Ethics Committee (UIN: 44441).

### Questionnaire Content

An online questionnaire was formatted using Google Forms®, presenting 63 questions, with a total of 159 sub-questions, the majority of which closed, multiple choice questions. These were designed to measure potential indicators of welfare, both health and behavioural, and aspects of housing and husbandry. The design was based upon that used to assess the current state of rabbit welfare in the UK [19]. Questions were divided into seven sections covering each of the five welfare needs [3] (Table 1).

1

**Table 1. Sections included within the questionnaire and related questions.**

| Section | Question Contents |
|---|---|
| A- Guinea pig | Number of guinea pigs owned, name of focal animal, sex, neuter status, age, breed, main caregiver, where obtained, initial companion(s). |
| B- Companionship | Current companion(s), frequency of social interactions and handling. |
| C- Housing | Position, type and size (height, width and depth) of main living enclosure, attached and separate runs (Summer and Winter), time the respondent was able to see guinea pigs each day, cleaning regimes. |
| D- Diet | Frequency and type of food, method of food presentation, water access, feeding routine. |
| E- Behaviour | Frequency of behaviours, owner perception of what behaviours represent, perceived happiness of guinea pig, reaction to caregiver. |
| F- Health | Frequency of weighing, grooming and nail clipping, whether each of 14 health conditions had ever been observed, how soon respondent perceived their guinea pig should receive veterinary treatment for each condition, how often the guinea pig usually visits a veterinary professional. |
| G- Respondent | Gender, age, whether working in an animal related profession, geographical area, details of any children in the household, any other pets, where heard about questionnaire, previous experience with guinea pigs and perceived confidence. |

To avoid bias caused by participants selecting the healthiest or best cared for guinea pig, if more than one was owned, they were asked to answer questions only for the guinea pig whose name came first alphabetically.

**Respondent Recruitment**

The questionnaire was open for four consecutive weeks from 13th January- 10th February 2017. A variety of recruitment methods aimed to recruit respondents, representative of the general UK population, including less enthused owners. Posters and fliers were created and placed in 15 locations, including schools, pet shops, garden centres, veterinary practices, supermarkets and staffrooms. Posts were placed on social media (Facebook®, Instagram®and Twitter®) and an article detailing the study was published on the University of Bristol website [26]. To encourage wider participation, respondents were offered the chance to enter a prize draw to win one of five prizes of

£40 worth of guinea pig products. Participants needed to be over 16 years and currently own a guinea pig.

**Data Handling**

Data were downloaded and exported to Excel (Microsoft Office 2013, Microsoft). Any duplicate responses were removed.

Behaviours were classified as either positive or negative based on descriptions in the published literature [6, 13, 23]. Negative behaviours were chewing on the bars of the cage and teeth chattering. Positive behaviours were the guinea pig lying on his/ her side, standing on his/ her hind legs, "popcorning"," wheeking" (high pitched vocalisation usually performed in anticipation of food or other reward) or gnawing items within the enclosure. Each positive behaviour was assigned a score based on the reported frequency of occurrence: 0=never; 1=occasionally; 2= regularly. The five scores were summed to derive a *Positive Behaviour Score* ranging from 0 to 10. We also calculated the total Number of Reported Health Issues.

The respondents' answers for the meaning of each of the seven behaviours were classified as correct or incorrect based on that described in the literature [6, 24]. The number of correct responses out of a total of seven was derived.

Statistical analysis was performed using IBM SPSS Statistics 23 for Window. Descriptive analysis described the housing and husbandry, and each of the potential welfare indicators. Statistical tests were used to explore each of the hypothesised relationships between housing/husbandry, and behaviour and health.

Data were not normally distributed, hence non-parametric tests were used throughout. Chi-Squared ($\chi^2$) tests compared two or more binary or nominal variables; Mann-Whitney-U (MWU) tests compared one binary variable and one continuous or ordinal variable and Spearman's Rank Order Correlation test (rho) for two continuous or ordinal variables.

## RESULTS

### Respondents

A total of 4719 responses were received, 129 respondents were excluded due to living outside of the UK leaving 4590. Most responses were obtained from the South West (Table 2: 20.4%), with recruitment via Facebook® generating the vast majority of responses (85.1%).

**Table 2. Characteristics of respondents completing the questionnaire.**

| Characteristic | Number of respondents (N=4590) | Percentage of respondents (%) |
|---|---|---|
| **Region of UK** | | |
| Channel Islands | 16 | 0.3 |
| East Midlands | 304 | 6.6 |
| East of England | 580 | 12.6 |
| Isle of Man | 5 | 0.1 |
| London | 178 | 3.9 |
| North East | 162 | 3.5 |
| North West | 381 | 8.3 |
| Northern Ireland | 18 | 0.4 |
| Scotland | 192 | 4.2 |
| South East | 724 | 15.8 |
| South West | 938 | 20.4 |
| Wales | 322 | 7.0 |
| West Midlands | 356 | 7.8 |
| Yorkshire | 414 | 9.0 |
| | | |
| **Recruitment Method** | | |
| Email | 14 | 0.3 |
| Facebook | 3906 | 85.1 |
| Online Forum | 20 | 0.4 |
| Google News | 19 | 0.4 |
| Instagram | 25 | 0.5 |
| LinkedIn | 18 | 0.4 |
| Newspaper/ Magazine | 22 | 0.5 |

| | | |
|---|---|---|
| Rescue/ Rehoming Centre | 222 | 4.8 |
| School | 54 | 1.2 |
| Twitter | 51 | 1.1 |
| University of Bristol Website | 18 | 0.4 |
| Veterinary Practice | 30 | 0.7 |
| Word of Mouth | 178 | 3.9 |
| Other (e.g. radio, pet shop, other internet sites) | 13 | 0.3 |
| | | |
| **Gender of respondent** | | |
| Male | 227 | 4.9 |
| Female | 4337 | 94.5 |
| Transgender | 10 | 0.2 |
| Prefer not to say | 16 | 0.3 |
| | | |
| **Age of respondent (years)** | | |
| 16-24 | 935 | 20.4 |
| 25-34 | 1438 | 31.3 |
| 35-44 | 1241 | 27.0 |
| 45-54 | 759 | 16.5 |
| 55-64 | 162 | 3.5 |
| >64 | 46 | 1.0 |
| Prefer not to say | 9 | 0.2 |
| | | |
| **Profession** | | |
| Non-animal related | 3771 | 82.2 |
| Veterinary Nurse (RVN or SVN) | 191 | 4.2 |
| Veterinarian | 55 | 1.2 |
| Others within Veterinary Practice (e.g. Receptionist, Animal Care Assistant) | 58 | 1.3 |
| Farm | 32 | 0.7 |
| Equine | 47 | 1.0 |
| Behaviourist | 10 | 0.2 |
| Groomer | 32 | 0.7 |
| Pet Shop | 67 | 1.5 |
| Rescue Centre/ Animal Charity | 85 | 1.9 |
| Other animal related | 242 | 5.3 |
| | | |
| **Children living in the household (age in years)** | | |
| No children | 2472 | 53.9 |
| <4 | 468 | 10.2 |
| 4-11 | 1290 | 28.1 |
| 12-17 | 1051 | 22.9 |
| | | |
| **Guinea pig caregiver** | | |
| The respondent | 3061 | 66.7 |
| Both the respondent and another adult within the household | 840 | 18.3 |
| Another adult within the household | 109 | 2.4 |
| Both the respondent and a child within the household | 435 | 9.5 |
| A child children within the household | 117 | 2.5 |

| | | |
|---|---|---|
| Other | 28 | 0.6 |
| | | |
| **Number of guinea pigs owned** | | |
| 1 | 678 | 14.8 |
| 2 | 2243 | 48.9 |
| 3 | 520 | 11.3 |
| 4 | 391 | 8.5 |
| 5 | 188 | 4.1 |
| 6 | 131 | 2.9 |
| 7 | 75 | 1.6 |
| 8 | 63 | 1.4 |
| 9 | 57 | 1.2 |
| 10 or more | 244 | 5.3 |

Most respondents believed themselves to be the guinea pig's main caregiver (66.7%), but 2.5% thought of their child or children as being solely responsible. The majority currently owned two guinea pigs (48.9%), with many also owning other pets (68.5%), including dogs (38.2%), cats (30.1%,) and rabbits (16.5%,). Overall, 17.8% of respondents worked within an animal-related profession, with Veterinary Nurse being the most reported job title amongst these (4.2%).

**Guinea Pigs**

In total, 51.8% of guinea pigs were male. A minority of guinea pigs were neutered (10.9%) but significantly more males (17.3%) than females (4.0%, ($\chi 2=151.7$, $p<0.001$)). The guinea pigs ranged in age from 0 to 13 years (mean= 2.6 years, standard deviation (SD) ± 1.8 years). Although there were twenty recorded breeds, Abyssinian (10%) was the most common pure breed, with the majority being either crossbreeds (19.0%) or of unknown breed (39.8%).

Pet shops were reported as the most common source of guinea pigs (38.4%), followed by rescue centres (25.8%), breeders (10.7%,) and friends, relatives or neighbours (10%). Thirteen (0.3%) guinea pigs had been strays.

## Companionship

When the guinea pigs were first obtained, 65.8% of respondents had simultaneously procured a conspecific, whilst 22.4% of guinea pigs had been obtained as a companion for an existing guinea pig, meaning 88.2% of guinea pigs were initially housed with a conspecific companion. In contrast, 9.0% were initially obtained to house on their own, and 0.8% were initially housed with a rabbit. At the time of the survey the proportion of guinea pigs housed with a conspecific was lower at 78.6%, whilst those housed with a rabbit was slightly higher (1.7%).

## Housing

It was most common for guinea pigs to be housed indoors during both Winter (69.4%) and Summer (53.6%), with 53.4% housed indoors all year round (Table 3). A hutch or cage without an attached run was the most common main living enclosure in both Winter (54.9%) and Summer (42.7%), but several other living arrangements were described.

**Table 3. Guinea pig living arrangements described by respondents.**

| | **In summer** | | **In winter** | |
|---|---|---|---|---|
| | **Number of guinea pigs (N=4590)** | **Percentage (%)** | **Number of guinea pigs (N=4590)** | **Percentage (%)** |
| ***Location*** | | | | |
| Indoor | 2459 | 53.6 | 3184 | 69.4 |
| Outdoor | 1635 | 35.6 | 599 | 13.1 |
| In a shed, garage or outbuilding | 496 | 10.8 | 807 | 17.6 |
| | | | | |
| ***Accommodation type*** | | | | |
| Hutch/cage without an attached run | 1960 | 42.7 | 2522 | 54.9 |
| Hutch/ cage with an attached run | 1035 | 22.5 | 519 | 11.3 |

| | | | | |
|---|---|---|---|---|
| Integrated run/ cage | 650 | 14.2 | 635 | 13.8 |
| Within a run/ pen | 444 | 9.7 | 402 | 8.8 |
| Free to roam in a room | 137 | 3.0 | 181 | 3.9 |
| Free to roam in a shed | 6 | 0.1 | 165 | 3.6 |
| Free to roam in a garden | 172 | 3.7 | 12 | 0.3 |
| Other | 189 | 4.1 | 154 | 3.4 |

Dimensions of the main enclosure were provided by 89.3% of respondents. The median surface area (assuming that each level of a multi-level enclosure was equal) was 0.77$m^2$(25$^{th}$ percentile 0.54$m^2$, 75$^{th}$ percentile 1.3$m^2$). When the total surface area was calculated per guinea pig, this ranged from 0.01$m^2$ to 400.6$m^2$, with a median size of 0.53$m^2$ (0.32$m^2$, 0.90$m^2$). The median height of the main enclosure was reported to be 55cm (42cm, 80cm).

Overall 94.7% of the respondents reported having an additional exercise area such as a run. These were most commonly separate runs which the animals had to be transferred into (85.0% of runs ), whilst only 23.8% of guinea pigs had access to a run that was attached to the home cage. Separate runs varied in size from 0.05$m^2$ to 12000$m^2$ (median= 1.8$m^2$; 1.0$m^2$, 3.2$m^2$). The frequency with which runs were used varied; in winter 33.1% of guinea pigs had access each day, whilst in summer this increased to 58.3%. The average length of time spent in the run ranged from less than an hour to eight hours or more, with the modal category being 2-4 hours in the summer, and 1-2 hours in the winter.

**Husbandry details**

The most common bedding material used on the cage floor hay (72.4%) and most animals were

cleaned out entirely each week (59%), with soiled materials commonly being removed several times a week (42.2%; Table 4).

**Table 4. Common bedding materials reported on the floor of the cag and cleaning regimes.**

| | **Percentage Using (%)** | | |
|---|---|---|---|
| **Bedding material** | | | |
| Hay | 72.4 | | |
| Wood-shavings | 46.7 | | |
| Newspaper | 42.3 | | |
| Fleece or blankets | 28.5 | | |
| Sawdust | 22.4 | | |
| Straw | 17.7 | | |
| Other | 19.2 | | |
| | | | |
| **Cleaning regime** | **Removal of soiled materials (%)** | **Removal of all materials (%)** | **Disinfection (%)** |
| Several times a day | 4.9 | 0.2 | 0.1 |
| Daily | 24.5 | 4.0 | 1.5 |
| Several times a week | 42.2 | 26.0 | 11.2 |
| Weekly | 26.0 | 59.2 | 47.5 |
| Fortnightly | 1.5 | 5.9 | 8.9 |
| Monthly or less | 0.9 | 4.8 | 30.7 |

Most guinea pigs were reported to be picked up at least daily (57.5%). However, 0.2% were never picked up. Grooming was generally infrequent, with only 33.9% being groomed weekly or more, and 15.2% never groomed. For many, nails were clipped less than monthly (27.2%) or not at all (6.9%), and the majority of guinea pigs were reportedly weighed less than weekly (89.7%) (Table 5).

**Table 5. Frequency with which guinea pigs were handled for various reasons.**

| | **Percentage of owners reporting weighing at different frequencies (N=4590)** | **Percentage of owners reporting grooming at different frequencies (N=4590)** | **Percentage of owners reporting nail clipping at different frequencies (N=4590)** | **Percentage of owners reporting picking up guinea pig at different frequencies (N=4590)** |
|---|---|---|---|---|
| Several times a day | N/A | N/A | N/A | 19.4 |
| Daily | 0.3 | 3.7 | N/A | 38.1 |
| Several times a week | 0.6 | 9.0 | 0.1 | 25.9 |
| Weekly | 9.4 | 21.2 | 2.5 | 11.6 |
| Fortnightly | 4.5 | 11.1 | 13.3 | 1.6 |
| Monthly | 17.3 | 20.2 | 50.1 | 1.8 |
| Less than Monthly | 24.4 | 19.5 | 27.2 | 1.3 |
| Never | 43.5 | 15.2 | 6.9 | 0.2 |

**Diet**

Constant access to at least one type of hay was reported to be available to 72.8% of guinea pigs, and 34.5% received Timothy hay at least daily (Table 6).

In total, 99.1% received some form of concentrates; pellets with added vitamin C were reportedly the most popular choice (76.7%), with muesli with added vitamin C second most popular (26.3%). Some animals reportedly received vitamin C in drinking water (12.7%), in chewable (10.7%), or liquid form (1.5%), meaning in total only 7.1% of the sample were not receiving supplements in some form.

Green vegetables were provided to 69.9% of guinea pigs at least daily and root vegetables to 59.4%, whilst herbs (17.7%) fruits (16.2%) and fresh grass (20.5%) were also common (Table 6).

**Table 6. Reported frequency with which 16 food types were available to guinea pigs.**

| | **Percentage of those responding reporting to feed with each frequency (%)** | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Never** | **Occasionally (less than weekly)** | **Weekly** | **Several times a week** | **Once daily** | **Twice Daily** | **Constant access** |
| Herbs e.g. parsley, coriander | 25.9 | 24.5 | 14.9 | 16.9 | 10.4 | 5.0 | 2.4 |
| Fruits e.g. apple, strawberries | 8.6 | 34.8 | 22.1 | 18.3 | 9.9 | 3.5 | 2.7 |
| Cucumber | 8.9 | 13.4 | 12.0 | 24.1 | 22.9 | 13.1 | 5.5 |
| Lettuce | 31.8 | 15.3 | 9.2 | 15.3 | 14.9 | 9.4 | 4.1 |
| Spinach | 22.1 | 22.5 | 13.5 | 19.2 | 11.5 | 7.7 | 3.5 |
| Root vegetables e.g. carrot | 0.7 | 5.1 | 9.1 | 25.7 | 35.5 | 16.5 | 7.4 |
| Green vegetables e.g. kale, cabbage, broccoli, cauliflower | 1.0 | 3.9 | 5.6 | 19.6 | 36.1 | 25.0 | 8.8 |
| Dandelions | 17.1 | 40.7 | 16.3 | 13.3 | 6.9 | 3.0 | 2.6 |
| Lawn mower clippings | 85.6 | 8.2 | 2.6 | 1.7 | 0.8 | 0.5 | 0.6 |
| Picked or growing grass | 18.9 | 28.9 | 14.6 | 17.1 | 9.5 | 4.4 | 6.6 |
| Readigrass | 67.5 | 13.2 | 3.2 | 4.8 | 4.4 | 1.3 | 5.6 |
| Timothy hay | 37.8 | 19.4 | 3.9 | 4.4 | 6.0 | 2.7 | 25.8 |
| Alfalfa hay | 74.1 | 17.9 | 2.2 | 2.1 | 1.2 | 0.4 | 2.0 |
| Bagged hay | 20.6 | 7.8 | 2.5 | 4.1 | 10.5 | 4.9 | 49.7 |
| Hay from a bale | 57.7 | 6.9 | 1.5 | 1.5 | 5.1 | 2.0 | 25.3 |
| Concentrates | 0.8 | 1.3 | 1.2 | 1.7 | 29.2 | 11.1 | 54.7 |

## Behaviour

Of the seven behaviours listed (Figure 1), most guinea pigs were reported to regularly (approximately daily) "wheek" (85.4%), lie on their sides (70.2%), and "popcorn" (54.0%). In contrast, 8.7% of guinea pigs were reported to never "popcorn", over a quarter (29%) regularly chattered their teeth and more than one in ten (12%) chewed on the bars of their cage on a regular basis.

**[Figure 1. Reported frequency at which seven different behaviours were displayed by guinea pigs.]**

When comparing the respondent's answer to the correct interpretation of behaviours (based on the literature), the most accurately identified behaviours were lying on the side being a sign of relaxation and chewing the bars being a sign of frustration. In contrast, 10.1% of respondents thought teeth chattering was a sign of happiness, rather than fear or frustration. Respondents' numbers of correctly identified behaviours ranged from 0-7 with a median of six, but only 24.9% were able to correctly identify all seven behaviours listed (Table 7).

**Table 7: Respondents' interpretation of seven behaviours. Answers considered correct, via comparison to scientific literature are shown in bold and shaded grey.**

| | Excited | Happy | Relaxed | Fearful | Frustrated | Unwell | Other |
|---|---|---|---|---|---|---|---|
| **Gnaw items within the enclosure** | 116 (2.5%) | **1373 (29.9%)** | **659 (14.4%)** | 80 (1.7%) | **1002 (21.8%)** | 63 (1.4%) | 1297 (28.3%) |
| **Chew the bars of his/ her enclosure** | 246 (5.4%) | 155 (3.4%) | 84 (1.8%) | 150 (3.3%) | **3338 (72.7%)** | 87 (1.9%) | 530 (11.5%) |
| **Chatter his/ her teeth** | 228 (5.0%) | 464 (10.1%) | 72 (1.6%) | **1737 (37.8%)** | **1688 (36.8%)** | 49 (1.1%) | 352 (7.7%) |
| **"Wheek"[1]** | **2641 (57.5%)** | **1487 (32.4%)** | 61 (1.3%) | 171 (3.7%) | 82 (1.8%) | 25 (0.5%) | 123 (2.7%) |

[1] high pitched vocalisation usually performed in anticipation of food or other reward

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **"Popcorn"[2]** | **2830 (61.7%)** | **1524 (33.2%)** | 12 (0.3%) | 122 (2.7%) | 41 (0.9%) | 9 (0.2%) | 52 (1.1%) |
| **Stand on his/ her hind legs** | **2376 (51.8%)** | **835 (18.2%)** | **111 (2.4%)** | 270 (5.9%) | 153 (3.3%) | 8 (0.2%) | 837 (18.2%) |
| **Lie on his/ her side or stretched out** | **5 (0.1%)** | **73 (1.6%)** | **4217 (91.9%)** | 8 (0.2%) | 3 (0.1%) | 254 (5.5%) | 30 (0.7%) |

## Health

The majority of respondents reported that most (57.4%) guinea pigs had experienced none of the listed conditions over their lifetime. The number reported ranged from 0 to 14. Skin parasites were reported as the most common health issue to affect guinea pigs (22.9%), whilst myiasis was the least commonly reported (0.5%; Table 8).

**Table 8: Percentage of guinea pigs reported to ever have experienced each of 14 conditions and the perceived urgency with which veterinary attention would be required if guinea pigs were to display each conditio .**

| | **Percentage of guinea pigs reported to have experienced condition** | **Perceived urgency with which veterinary treatment would be required if guinea pigs displayed each condition** | | | | |
|---|---|---|---|---|---|---|
| | | **Same day** | **Within 2-3 days** | **Within 4-7 days** | **After 7 days** | **Never** |
| **Anorexia** | 6.5% | 49.6% | 37.1% | 7.8% | 5.0% | 0.4% |
| **Dental disease** | 4.9% | 61.2% | 27.3% | 5.8% | 4.9% | 0.7% |
| **Gut stasis** | 2.9% | 66.9% | 24.4% | 4.7% | 3.6% | 0.4% |
| **Diarrhoea** | 9.3% | 55.7% | 33.3% | 6.4% | 4.1% | 0.6% |

[2] rapid locomotion in which the animal jumps into the air with all four limbs off the ground, often accompanied by rapid running and turning in multiple directions

| | | | | | | |
|---|---|---|---|---|---|---|
| **Anuria or haematuria** | 5.2% | 82.3% | 11.9% | 1.9% | 3.4% | 0.4% |
| **Lethargy** | 7.1% | 46.4% | 36.8% | 10.2% | 6.1% | 0.5% |
| **Myiasis** | 0.5% | 85.3% | 8.2% | 2.3% | 3.4% | 0.8% |
| **Stiff when walking** | 2.4% | 37.9% | 43.6% | 11.6% | 6.0% | 0.9% |
| **Head tilt** | 2.9% | 62.5% | 24.7% | 6.8% | 4.9% | 1.1% |
| **Lump or swelling** | 12.4% | 42.4% | 42.5% | 9.5% | 4.9% | 0.7% |
| **Respiratory issues** | 8.5% | 86.8% | 7.9% | 1.6% | 3.3% | 0.4% |
| **Ocular opacities** | 9.8% | 41.7% | 41.9% | 9.6% | 6.0% | 0.8% |
| **Skin parasites** | 22.9% | 53.2% | 32.2% | 6.8% | 4.9% | 2.9% |
| **Ovarian cysts** | 2.4% | N/A | N/A | N/A | N/A | N/A |

When asked how frequently their guinea pig was taken to a veterinary practice to see either a veterinarian or a veterinary nurse, the majority reported only if the owner believed they were unwell (74.4%), whilst as a minority, 12.8% visited at least every six months. The reported speed with which respondents would seek veterinary attention if the guinea pig were to experience each of 14 conditions varied (Table 8). Respiratory issues (86.8%), myiasis (85.3%) and anuria or haematuria (82.3%,) were identified as the most in need of same day attention.

**Life Span**

Overall, 3390 respondents provided details of the age at which their last guinea pig died, with a

mean age at death of 4.1 years (SD ± 3.1 years). Ages ranged from one month to over 20 years. Ten guinea pigs were reported to have lived for 20 years or more.

**Testing associations between housing and husbandry and behaviour and health**

Guinea pigs currently living with a conspecific companion were found to have a significantly higher *Positive Behaviour Score* (Median= 8; 7, 9) than those living without (Median= 7; 6, 9: MWU=1572865.0=, $p<0.001$). In contrast, those currently living with a rabbit had significantly lower *Positive Behaviour Scores* (Median=7; 5, 8) than those living without a rabbit (Median=8; 6, 9: MWU=60318.0, $p<0.001$). Enclosure size was also found to correlate with *Positive Behaviour Score* (rho=0.04, p=0.01).

The frequency with which guinea pigs were reported to be fed green vegetables was negatively correlated with the *Number of Reported Health Issues* (rho=-0.34, p=0.021). No significant association was found between enclosure size and *Number of Reported Health Issues* (rho=-0.03, p=0.87).

## DISCUSSION

This is the first study to sample a large number of guinea pig owners, with 4590 respondents together owning over 14,079 guinea pigs. This represents an estimated 3.5% of the UK guinea pig population [1]. They were kept in a variety of ways and for many guinea pigs, the care they were receiving closely matched the needs outlined by available literature. For example, research suggests that guinea pigs should be able to “popcorn”, vocalise, stand on their hind legs and lie stretched out [5, 6, 27], behaviours noted by a large proportion of respondents. However, 8.7% of the owners

never saw their guinea pigs “popcorn”, 16.9% never saw them stand on their hind legs, and significant numbers reported them cage gnawing (37.2%) and teeth chattering (71.1%). Even in this self- selected sample, a number of potential welfare issues have been identified, suggesting additional steps could be taken to further improve guinea pig well-being.

**Lack of appropriate companionship**

Guinea pigs living with conspecific companions displayed significantly more positive behaviours than those living without another guinea pig, and those living with a rabbit displayed significantly fewer than those living without. This shows that welfare is enhanced by living with compatible conspecifics, likely as this facilitated social behaviours, but also reduced stress as has previously been demonstrated [8,9] whilst in contrast living with a rabbit can lead to additional stress. Not only do rabbits and guinea pigs require differing diets, but there is potential for the rabbit to inflict injury, and to cause unnecessary via bullying [6, 10, 11, 12]. Hence the guinea pigs in this study living with rabbits may have shown reduced positive behaviours as they lacked the possibility of engaging in social play and other positive interactions, as well as their increased background stress levels potentially reducing their exhibition of relaxed behaviours. This backs up previous recommendations, that conspecific company is important for guinea pig welfare [5, 6, 11, 20], but rabbits are generally unsuitable companions.

In this sample, 21.4% of guinea pigs were currently living without other conspecifics and 1.8% were living with a rabbit. It is noteworthy that fewer guinea pigs were reported to currently live with a conspecific companion (78.6%) than did so when initially obtained (88.2%). This suggests owners often don’t replace deceased animals, which may be due to a variety of reasons. Re-bonding older animals can raise both ethical and practical issues, where owners have to weigh up the risks and potential gains. However, since group-housed animals have been shown to experience better

welfare [8], additional resources to help owners make informed decisions and describing how to best introduce older animals, may be beneficial.

**Lack of an adequately sized enclosure**

Whilst the majority of guinea pigs were found to live in enclosures larger than requirements specified by the British Cavy Council (0.28$m^2$per guinea pig) [4] and laboratories (0.25$m^2$ per guinea pig) [13, 20], nearly one in five guinea pigs (18.2%) were housed in an enclosure smaller than this. As enclosure size increased, the frequency with which positive behaviours were reported also increased. Some behaviours such as lying on the side and popcorning, require adequate space to be performed, but it is also likely that increasing space provision increases positive affect in the animal, and hence predisposes them to exhibit these behaviours. This is similar to findings in pet rabbits, which showed a larger behavioural repertoire and frequency of positive behaviours displayed in those housed in larger enclosures [13, 28]. Of those guinea pigs living in enclosures smaller than 0.28$m^2$, the majority were a hutch or cage (73.2% in Winter and 72.2% in Summer), raising questions regarding the size of accommodation currently marketed as suitable for guinea pigs. Further research into optimal size of enclosures may therefore be beneficial.

**Importance of diet**

Encouragingly, 72.8% of guinea pigs were provided with constant access to at least one type of hay, considerably higher than the 30% of rabbits reported to have constant access by PDSA[2], although this may be due to differences in the type of respondents recruited. However, whilst Timothy hay is often considered as the most suitable hay for guinea pigs, due to its low calcium and calorific content [29, 17, 30, 31], only 34.4% of guinea pigs received this daily. Owners may be choosing hay type based upon cost, or may lack knowledge of the different types available; increased information dissemination may be beneficial.

The majority of guinea pigs were reported to receive green vegetables at least daily (69.9%), and many were given concentrates, soluble or chewable vitamin C supplements .Therefore, it is likely that they were obtaining sufficient vitamin C. However, 4.9% received greens less than weekly. Provision of vegetables is likely enriching , even for animals receiving sufficient Vitamin C in other forms. There was also a relatively high proportion of guinea pigs given daily access to fruits (16.2%) and root vegetables (59.4%), foods which contain high sugar content [24], and may be detrimental to health. Clearer information about the types of fresh foods and hay suitable for guinea pigs and quantity which these should be fed, may help to ensure that the correct types of nutrition are provided.

**Importance of veterinary attention**

It is often stated that guinea pigs can deteriorate quickly if unwell [20] and should therefore receive veterinary treatment rapidly if illness is suspected. Having asked respondents how quickly they thought veterinary treatment would be required if their guinea pig were to display certain symptoms, the importance of same day veterinary attention was generally identified for symptoms such as anuria or haematuria (82.3%), respiratory issues (86.8%) and myiasis (85.3%). Other serious health issues, such as anorexia (49.6%), dental disease (61.2%), gut stasis (66.9%), diarrhoea (55.7%), lethargy (46.4%) and ocular opacities (41.7%), were seen as urgent by far fewer respondents. Worryingly, more respondents thought same day treatment would be necessary for skin parasites (53.2%), than anorexia, lethargy, or ocular opacities. This highlights the need for increased education regarding the importance of promptly seeking veterinary attention for such symptoms.

Popular veterinary advice is that guinea pigs should be seen by a veterinary professional at least every six months [11], but in this sample only 12.8% of guinea pigs received six monthly health checks. This may partly be due to no requirement for routine vaccinations in the species [11, 21]. The majority of this sample only visited a veterinary practice if the owner believed they were unwell

(74.4%), suggesting veterinary contact is often limited, which may limit the capacity of veterinarians to impart knowledge on optimal husbandry care. In contrast, most owners procured their guinea pigs from a pet shop (38.4%) and hence this, as well as online resources, represents an important route for potential education, and it is vital that information imparted is current, evidence-based and consistent.

Health monitoring at home was variable, with the majority of guinea pigs weighed less than weekly (89.7%), and 67.9% weighed less than monthly. Weight change can be an early indicator of health and well-being issues [10], and this apparent lack of vigilance may result in health issues being under-reported.

**Longevity**

Past estimates of guinea pigs' longevity are few, but range from 4 to 9 years [10, 11, 20] and may be underestimates due to asking the age of animals that are currently alive. Here we asked respondents about the age at death of their last guinea pig, thereby avoiding such left skew. Whilst the mean age of death did fall within this suggested window (4.1 years), this may suggest life expectancy is lower than often stated. Nonetheless, 5.2% of guinea pigs lived beyond the age of nine.

**Limitations**

This study employed a wide variety of distribution methods, as well as use of a financial incentive, aimed to gather a diverse population sample. However, self-selection and the majority of recruitment being through social media, means there is still likely over-representation of enthusiastic, motivated owners, and hence the welfare state in the population overall may be less positive than the study suggests. Additionally, it has previously been found that families with children are less likely to complete online surveys regarding their pets [31], and some owners may

not have internet access; it may therefore be useful in future to also offer the survey in written form and over the telephone, to allow for differing demographics to be reached. However, the associations identified between aspects of housing and husbandry and welfare are still likely meaningful.

## CONCLUSION

This study gathered a large amount of data on guinea pig care, from an extremely large sample of owners. As the first large scale study conducted in the UK, it also provides valuable baseline data by which to compare future surveys and the impact of future interventions.

The study has identified several key welfare concerns which should be addressed including the importance of suitable companions and the need for a large enough enclosure, both of which have been shown to influence the frequency of positive behaviours displayed. Additionally, increased availability of vitamin C-rich vegetables was linked to a reduced reported incidence of health issues, and hence we suggest that education regarding the most appropriate nutrition and the likely benefits of regular veterinary and home health checks would be advantageous. Finally, the research shows greater awareness of when guinea pigs require immediate veterinary attention would likely prove beneficial. Although such information is currently available, it is generally accompanied by a large amount of less evidence-based information, making it hard for owners to identify the most important materials to read.

The development of a governing body for guinea pigs, similar to the Rabbit Welfare Association and Fund for rabbits, may be beneficial to allow for evidence-based, information to be made readily available to owners, especially for those who may not regularly visit a veterinary practice.

**Acknowledgements**

We are very thankful to Burgess Pet Care, Rosewood Pet Products and Supreme Petfoods for generously donating participant incentives, which undoubtedly contributed to the questionnaire's success. Special thanks to everyone who shared study details, in particular RSPCA, PDSA and BVA for their posts on social media, all the schools who shared the questionnaire in their newsletters and all the organisations who displayed posters about the study; without whom the success of this study would not have been feasible. Finally, we would like to thank everyone who took the time to complete the questionnaire.

## References

[1] PFMA. (2019). *Pet Population 2019.* Available: https://www.pfma.org.uk/pet-population-2019. Last accessed 2nd November 2019.

[2] PDSA. (2018). *PDSA Animal Wellbeing Report 2018.* Available: https://www.pdsa.org.uk/media/4371/paw-2018-full-web-ready.pdf. Last accessed 1st August 2018.

[3] GOV UK. (2006). *Animal Welfare Act 2006 Chapter 45.* Available: http://www.legislation.gov.uk/ukpga/2006/45/pdfs/ukpga_20060045_en.pdf. Last accessed 2nd November 2019.

[4] Neesam, S. (2015). *Welfare guidance for proper care of cavies.* Available: http://www.britishcavycouncil.org.uk/Welfare/. Last accessed 2nd November 2019.

[5] RSPCA. (2011). Guinea pigs: Good practice for housing and care. *Research Animals Department*. p1-5.

[6] RSPCA (2015). How to take care of your *guinea pigs*. West Sussex: RSPCA. p1-20.

[7] Sascher, N. (1998) *Was bringen Praferenxtests*? In: Akuelle Arbeiten zur artgemaBen. Tirehaltung 1997. KTBL Schrift 380, Darmstadt p 9-20.

[8] Sachser, N., Künzl, C. & Kaiser, S.. (2007). Chapter 9: The Welfare of Laboratory Guinea pigs. In: Kaliste, E *The Welfare of Laboratory Animals*. The Netherlands: Springer. p181-209.

[9] Sachser, N, Durschlag, M & Hirzel, D. (1998). Social Relationships and the Management of Stress . *Psychoneuroendocrinology*. 23 (8), p891-904.

[10] Fawcett, A. (2011). Management of husbandry-related problems in guinea pigs. *In Practice*. 33 (1), p163-171.

[11] Mancinelli, E. (2016). Guinea pig husbandry- housing, diet and handling. *Vet Times*. 46 (49). Available: https://www.vettimes.co.uk/article/guinea-pig-husbandry-housing-diet-and-handling/. Last accessed 30th October 2019.

[12] RSPCA. (2016). *Keeping rabbits and guinea pigs together.* Available: https://www.rspca.org.uk/adviceandwelfare/pets/rabbits/company/rabbitsandguineapigs/-/articleName/CADKeepingRabbitsAndGuineaPigsTogether. Last accessed 30th October 2019..

[13] Dixon, L, Hardiman, J & Cooper, J. (2010). The effects of spatial restriction on the behaviour of rabbits (Oryctolagus cuniculus). *Journal of Veterinary Behavior*. 5 (1), p302-308.

[14] Held, S, Mullan, S, Saunders, R, Blackwell, E & Rooney NJ 2012. An investigation of the spatial Needs of Socially housed pet rabbits. Report to RSPCA

[15] Anderson, L. (1987). Guinea Pig Husbandry and Medicine. *The veterinary clinics of North America*. 17 (5), p1045-1060.
[16] ] Richardson, V (2000). Diseases of Domestic Guinea Pigs. 2nd ed. Oxford: Blackwell Science Ltd. p1-144.
[17] Clauss, M. (2012).Clinical Technique : Feeding Hay to Rabbits and Rodents . *Journal of Exotic Pet Medicine*. 21 (1), p80-86.
[18] Animal Research Review Panel (ARRP) (2006). *Guideline 21 Guidelines for the Housing of Guinea Pigs in Scientific Institutions*. Orange NSW: Animal Welfare Branch NSW Department of Primary Industries. p1-58.
[19] Rooney, N, J, Blackwell, E, J, Mullan, S, M, et al. (2014). The current state of welfare, housing and husbandry of the English pet rabbit population. *BMC Research Notes*. 7 (942), p1-13.
[20] Richardson, V. (2011). Care of guinea pigs. *Veterinary Nursing Journal*. 26 (1), p447-449.
[21] Meredith, A. (2015). Guinea pigs: common things are common. *Veterinary Record*. 177 (8), p198-199.
[22] Minarikova, A, Hauptman, K, Jeklova, E, et al. (2015). Diseases in pet guinea pigs: a retrospective study in 1000 animals. *Veterinary Record*. 177 (8), p200-208.
[23] Held, S.D.E & Spinka, M. (2011). Animal play and animal welfare. *Animal Behaviour*. 81 (1), p891-899.
[24] Garner-Richardson, V. (2012). Guinea pig nutrition. *The Veterinary Nurse*. 3 (5), p274-282.
[25] Roberts-Steele, S., Oxley JA, Carroll A, & Willis AP. 2019 Frequency of Owner-Reported Bacterial Infections in Pet Guinea Pigs *Animals* 2019, *9*(9), 649; https://doi.org/10.3390/ani9090649
[26] University of Bristol. (2017). *Calling all guinea pig owners.* Available: http://www.bristol.ac.uk/news/2017/february/guinea-pig-study.html. Last accessed 2nd November 2019.
[27] Donnelly, M. (2015). Guinea Pigs. In: Liss, C., Litwak, K., Tilford, D. & Reinhardt, V *Comfortable Quarters for Laboratory Animals*. 10th ed. Washington: Animal Welfare Institute. p40-47.
[28] Rooney NJ. Mullan S, Saunders R, Blackwell EJ, Held S. 2012 Assessment of the State or Rabbit welfare in The UK and Prioritisation of the Welfare Issues, Report to RSPCA
[29] Ackerman, N. (2012). Rabbit Nutrition. In: Ackerman, N *The Consulting Veterinary Nurse*. Sussex: Wiley-Blackwell. p80-84.
[30] Johnson-Delaney, C. (2010). Guinea pigs, chinchillas, degus and duprasi. In: Meredith, A & Johnson-Delaney, C *BSAVA Manual of Exotic Pets*. 5th ed. Gloucester: British Small Animal Veterinary Association. p28-62.
[31] Oxbow Animal Health. (2009). *Guinea Pig Care Guide.* Available: http://www.oxbowanimalhealth.com/uploads/files/Guinea-Pig-Care-Guide.pdf. Last accessed 2nd November 2019.